5 Development of PCB Action Levels for the Lower Fox River and Green Bay

This section of the FS puts forward a rational basis for developing remedial action levels from the array of sediment quality thresholds (SQTs) developed earlier in Section 4. An SQT is a risk-based PCB threshold in sediments derived to be protective of specific human health pathways and ecological receptors (fish, avian, or mammal). An action level is a specific PCB cleanup goal carried forward in the FS that considers the level of risk reduction estimated from the SQT thresholds and the variety of PCB concentrations present at the site. Both SQTs and remedial action levels were derived with the assumption that a remedial action targeting PCBs would also capture the other COCs. This section evaluates a series of PCB action levels that brackets the array of SQTs. These action levels result in different volumes/masses of sediment removed, and different levels of risk reduction (Figures 5-1 and 5-2). Unless the most stringent SQT is set as the cleanup goal for the Lower Fox River and Green Bay (correlating to the 125 ppb PCB action level), then some level of risk will remain at the site after remediation. The levels of remaining risk will be discussed and evaluated in Sections 8 and 10 of this FS.

Residual risk in sediments may be quantified in terms of COC concentrations at discrete locations or surface-weighted average concentrations (SWAC) in surface sediments. Cleanup to a higher concentration (absolute concentration or SWAC) may be protective in the long term. The dynamics of the Lower Fox River and Green Bay aquatic systems promote the slow decline of surface sediment concentrations by natural processes (e.g., sedimentation). Thus, actions to remove and isolate or treat sediment to higher levels may be acceptable if natural processes can be relied upon to return sediment COC concentrations to protective levels in a reasonable time frame.

This section presents a rationale for adopting specific PCB action levels central to the evaluation of remedial alternatives that involve sediment removal (dredging) or isolation (capping). As discussed in Section 4, these are often the most important active general response actions to consider for sediment cleanup. Indeed, the alternatives developed and evaluated in Section 7 that involve active remediation arise principally from these two response actions. Valuations are therefore presented for the following key parameters:

- Sediment volume removed or isolated under an active management alternative,
- Mass of PCB removed or isolated in sediments, and
- Residual surface-weighted average concentrations (SWAC) following sediment removal.

Results of the volume, mass, and SWAC calculations are presented for each river reach and for each zone of Green Bay.

5.1 Rationale

Action levels are COC concentrations in surface sediments designed to meet project expectations and RAOs. These action levels represent safe thresholds in surface sediment that are protective of both human and ecological receptors. However, action levels that precipitate an active removal or containment action may include or exceed cleanup levels established by chemical-specific ARARs or risk assessment to satisfy project RAOs. In these cases, action levels depend on natural processes capable of further reducing risks in the long term (e.g., sedimentation, degradation, dispersion). Therefore, an evaluation of alternatives at action levels above SQTs necessarily requires a predictive capability. For this site, four fate and transport, and exposure models will be used to determine whether or to what extent cleanup to an action level is capable of meeting RAOs within a reasonable time frame. These computer models include:

- Whole Lower Fox River (wLFR) Sediment Fate and Transport Model,
- Lower Fox River Food Web Model (FRFood),
- Green Bay Toxicity (GBTOXe) Fate and Transport Model, and
- Green Bay Food Web Model (GBFood).

These fate, transport, and exposure models for the Lower Fox River and Green Bay predict the distribution of COCs (in this case PCBs) as a function of time in both sediment and the water column. The evaluation of alternatives (Section 8) compares the relative benefits of short-term risk reduction (immediate attainment of protective concentrations) and longer term natural attainment of protective concentrations following removal or capping to a higher action level.

5.1.1 Array of SQTs

The Final Baseline Human Health and Ecological Risk Assessment (RETEC, 2002b) developed SQTs that provide receptor-specific protective PCB concentrations (Section 3). These SQTs were based upon bioaccumulation modeling from tissue concentrations of PCBs in fish that placed human or ecological receptors at risk. The SQTs, and some of the critical receptors they were intended to protect for both the Lower Fox River and Green Bay, are shown on Figures 5-1 and 5-2 for human health and ecological health, respectively. For the purposes of this FS, SQTs are expressed in μg/kg units. SQTs themselves are not cleanup criteria, but are a good approximation of protective sediment values and can be considered to be "working values" from which to select a remedial action level. SQTs are used to evaluate harmful levels of chemicals that must be addressed, what levels of those chemicals can be safely left behind, and which remedial option offers the best risk reduction. From the array of PCB-SQTs for specific human health and ecological receptors, the response agencies can evaluate risk reduction and select cleanup standards, or remedial action levels for the Lower Fox River and Green Bay, at the conclusion of the feasibility study. Limits on the application of SQTs for predicting future risk are discussed in Section 3.

5.1.2 Array of Action Levels

The action levels selected for evaluation (125, 250, 500, 1,000, 5,000, and 10,000 parts per billion [ppb] PCBs) bracket the risk-based SQTs for human and ecological receptors discussed in Section 3 (see Figures 5-1 and 5-2). Action levels carried forward in the FS were selected based on several considerations:

- Select an array of action levels that bracket the human health and ecological SQT values;
- Select lowest action level where residual SWAC is protective of approximately 90 percent of human/ecological receptors (Section 3);
- Select highest action level (minimal protection) where residual SWAC is protective of approximately 10 percent of human/ecological receptors (Section 3);
- Consider the implementability of concentration levels based on precedent set on other sediment remediation projects (i.e., dredging, capping, natural recovery) (Appendices B and C); and
- Select an array of action levels that bracket a commonly implemented action level of 1 ppm PCBs. The array includes multiples of the 1 ppm action level including 10×, 5×, 0.5×, 0.25×, and 0.125×.

For the purposes of this FS, action levels are expressed in ppb units. Action levels are remediation cleanup criteria for sediments that define the size of the dredge prism requiring removal.

The analysis presented here partitions the sediment volumes and associated PCB mass distribution between those that exceed a given action level and those that are below the same action level. Further, the analysis estimates the SWAC for the PCB residual following hypothetical removal of material exceeding the action level. Trends in the relationships between the three parameters (volume, mass, SWAC) can be used to subjectively determine which specific action levels to retain for fate and transport modeling. Ultimately, output from the Fox River and Green Bay models determines how much time is required for fish tissue concentration to reach acceptable levels (Section 8). The relationship between action level and restoration time (i.e., time to reach acceptable fish tissue concentrations) is central to the comparative evaluation of alternatives in Section 10.

5.2 Procedures for Estimating Sediment Volume, Mass and SWAC

As part of the Remedial Investigation (RETEC, 2002a), interpolated concentrations of sediment properties through the entire areal and volumetric extent of the Lower Fox River and Green Bay were developed based on data from the Fox River Database (FRDB). The interpolation profiles sediment bed properties (PCB concentration, PCB mass, dry bulk density, and sediment thickness) across the four reaches of the Lower Fox River and the three zones of Green Bay. ArcView GIS software with Spatial Analyst uses the data profiles to compute where sediment quality exceeds the action level and therefore what sediment requires remedial action (removal or isolation). Further, the same software enables calculation of a post-removal or post-isolation SWAC profile. The specific methods for interpolation were summarized in Section 2.4.2 of the FS.

The volume and mass computations use the same basic method of analysis. The interpolated sediment profile was analyzed from bottom to top to determine locations that exceed the action level. Any material that exceeded the action level, or was located above a depth that exceeds the action level, was included in the volume and mass calculation. Locations within layers that do not contain sediment or sediment that is less than half the model layer thickness (i.e., station thickness is only 10 cm in a 30-cm-thick layer) are not included in the volume and mass analyses. Locations that exist outside of the defined "deposits" known as "interdeposit areas" that exceed the selected action level were also included in

the PCB mass and volume estimates requiring removal. The specific step-wise procedure for these calculations is provided in Table 5-1.

A similar approach computes the SWAC for material remaining at the surface following hypothetical removal. For undredged areas, the new surface concentration at a location is the same as the concentration in the interpolated surface concentration. In dredged areas, the new surface concentration is taken as the concentration in the layer below the dredged layer. If the bottommost layer is removed, then the new surface concentration is assumed equal to the action level. Areas that do not contain sediment or where sediment thickness is less than half the model layer thickness are assumed to have a PCB concentration of 50 μg/kg. The SWAC was computed for each river reach by summing the new surface concentration over the entire reach and then dividing by the area of the reach. The step-by-step procedure for the SWAC calculations is provided in Table 5-2. For the purposes of this FS, SWAC values are expressed in μg/kg units.

5.3 Lower Fox River Results

Results of the action level analysis for sediment volumes, associated mass of PCBs, and SWACs are presented in the accompanying tables and figures. Table 5-3 shows the estimated volume and mass values by identified deposits within each reach. As expected from the RI data, the majority of contaminated sediment volume and PCB mass resides in the De Pere to Green Bay Reach. The Appleton to Little Rapids Reach contains the least sediment volume and PCB mass. Table 5-4 presents the calculated SWAC values exposed at the surface after dredging for each reach.

Figure 5-3 presents sediment volume as a function of action level. The percentage values embedded in the graphs represent the percent differences between bracketing volume estimates. For example, there is a 56 percent difference between the calculated sediment volumes at action levels of 125 and 250 ppb in the Appleton to Little Rapids Reach. Figure 5-3 demonstrates the sensitivity of sediment volume to action level across most of the Lower Fox River. With the exception of the De Pere to Green Bay Reach (below 1,000 ppb action level), sediment volumes decline appreciably as a function of action level. This strong dependency of volume to action level bears directly on remedial costs, particularly for cleanup alternatives that involve dredging.

Figure 5-4 relates PCB mass removed to action level. The embedded percentage values, in this case, are the percentages of PCB mass removed relative to the total present at the lowest action level (i.e., 125 ppb). The assumption here is that the PCB mass at 125 ppb is a reasonable estimate of the total mass present that could pose a risk. Figure 5-4 shows that, for the most part, PCB mass is considerably

less sensitive to action level than sediment volume at the lower end of the range (e.g., less than 1,000 ppb). Thus, for example, one can remove 96 percent of the PCB mass in the Little Rapids to De Pere Reach at the 500 ppb action level with just 55 percent of the sediment volume (i.e., relative to the estimated volume at the 125 ppb action level).

Figure 5-5 presents the mass and volume calculations in a single graph for each reach. This figure perhaps best illustrates how efficiently the PCB mass and/or sediment volume can be removed or isolated at a selected action level.

Figure 5-6 shows the relationship between SWAC and action level for the four reaches. SWAC is less sensitive to action level in the Appleton to Little Rapids Reach because of the low levels of PCBs found in this section of the river. In the remaining three reaches, SWAC is considerably more sensitive to action level. Note in Figure 5-6 that the 1,000 ppb action level yields a residual SWAC reasonably close (within a factor of 2) to the lowest cleanup action levels (i.e., 125 and 250 ppb) proposed for the FS. The cleanup action level of 5,000 ppb yields a residual SWAC value that is three to four times higher than 250 ppb (the lower action level). Conversely, it should be noted that there is little difference in the residual SWACs between 125 and 250 ppb action levels. These results suggest that 5,000 ppb is a reasonable upper limit action level for evaluating cleanup alternatives considering the time required to reach protective levels (the SQT of 250 μg/kg) by natural processes following sediment removal or containment actions.

5.4 Green Bay Results

Table 5-5 presents sediment volume, PCB mass and SWAC values for Green Bay at action levels of 125, 250, 500, 1,000 and 5,000 ppb. Figure 5-7 presents sediment volume as a function of action level for each zone. Sediment volume is very sensitive to action level, particularly in zones 2A, 3A, and 3B. The lowest two action levels correspond with extraordinarily large sediment volumes (greater than 100,000,000 cubic meters [m^3]) most of which reside in zones 3A and 3B. Even at the 1,000 ppb action level, where the impacts are limited to zones 2A and 2B, the calculated sediment volume is in excess of 20,000,000 m^3.

PCB mass is not very sensitive to action level in zones 2A and 2B (Figure 5-8). Approximately 90 percent of the total mass of PCBs in zones 2A and 2B (i.e., at concentrations equal to or greater than 125 μg/kg) can be removed at the 1,000 ppb action level. Further from the mouth of the river (zones 3 and 4) the majority of the mass occurs at concentrations of 250 μg/kg or less. Figure 5-9 further illustrates these trends by directly relating sediment volume to PCB mass.

Figure 5-10 presents SWAC as a function of action level. SWAC is most sensitive to action level in zones 2A and 2B, where the most significant sediment impacts reside. The SWAC in Zone 3A is slightly above the 250 μg/kg benchmark at the highest action level, while in Zone 3B the maximum SWAC is a little more than twice as high. The SWAC in Zone 4 is less than one-half the SQT of 250 μg/kg, regardless of action level.

5.5 Selection of Action Levels for Evaluation of Remedial Alternatives

Remedial alternatives for the Lower Fox River that involve containment (capping) or removal (dredging) will be developed for action levels of 125, 250, 500, 1,000, and 5,000 ppb. For Green Bay, containment and removal alternatives will be developed for action levels of 500, 1,000, and 5,000 ppb. The 10,000 ppb action level was eventually dropped from the Lower Fox River evaluation because the bulk of PCB-impacted sediments were addressed at the 5,000 ppb level, and the 10,000 ppb level was not considered adequately protective of valued receptors to warrant further consideration. The 10,000 ppb action level was dropped from the Green Bay evaluation since the maximum detected concentration in Green Bay was below 10,000 μg/kg. The lowest two action levels were dropped from the Green Bay analysis simply based on the massive volume of sediment requiring removal and disposal. Finding a disposal site with adequate capacity would be technically and administratively challenging and improbable. The corresponding estimates of affected area, sediment volume, PCB mass, and SWAC are central to the development and evaluation of remedial alternatives in subsequent sections of this document (Sections 7, 8, and 9). Following are several key aspects of the cleanup alternatives that are strongly influenced by action level:

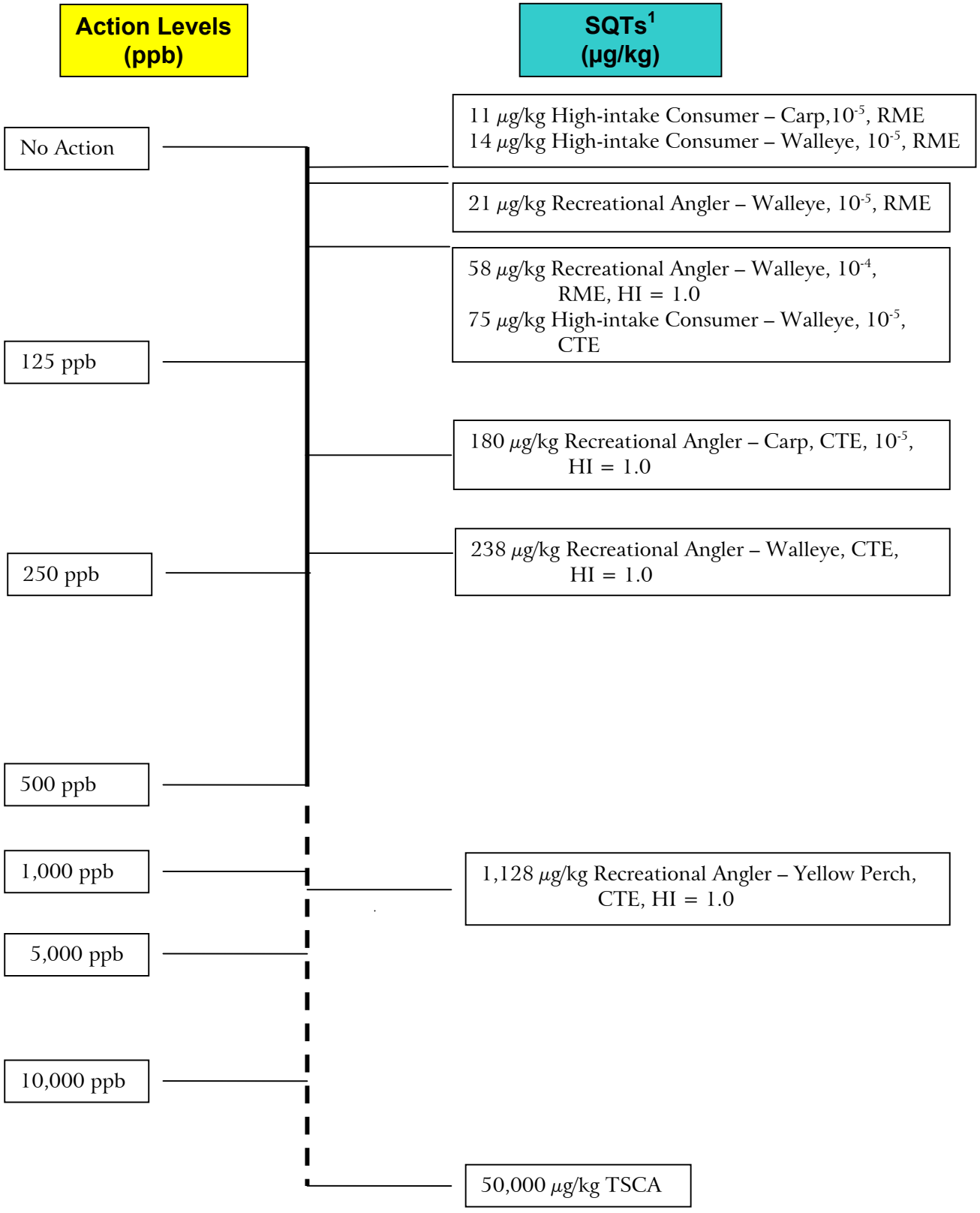
- Facility and equipment sizing,
- Siting requirements,
- The duration of active cleanup operations,
- Duration of monitoring and maintenance programs,
- Time to reach protective concentrations through natural processes, and
- Costs.

5.6 Section 5 Figures and Tables

Figures and tables for Section 5 follow page 5-8 and include:

Figure 5-1 Action Levels and Sediment Quality Thresholds for Human Health
Figure 5-2 Action Levels and Sediment Quality Thresholds for Ecological Health

Figure 5-1 Action Levels and Sediment Quality Thresholds for Human Health

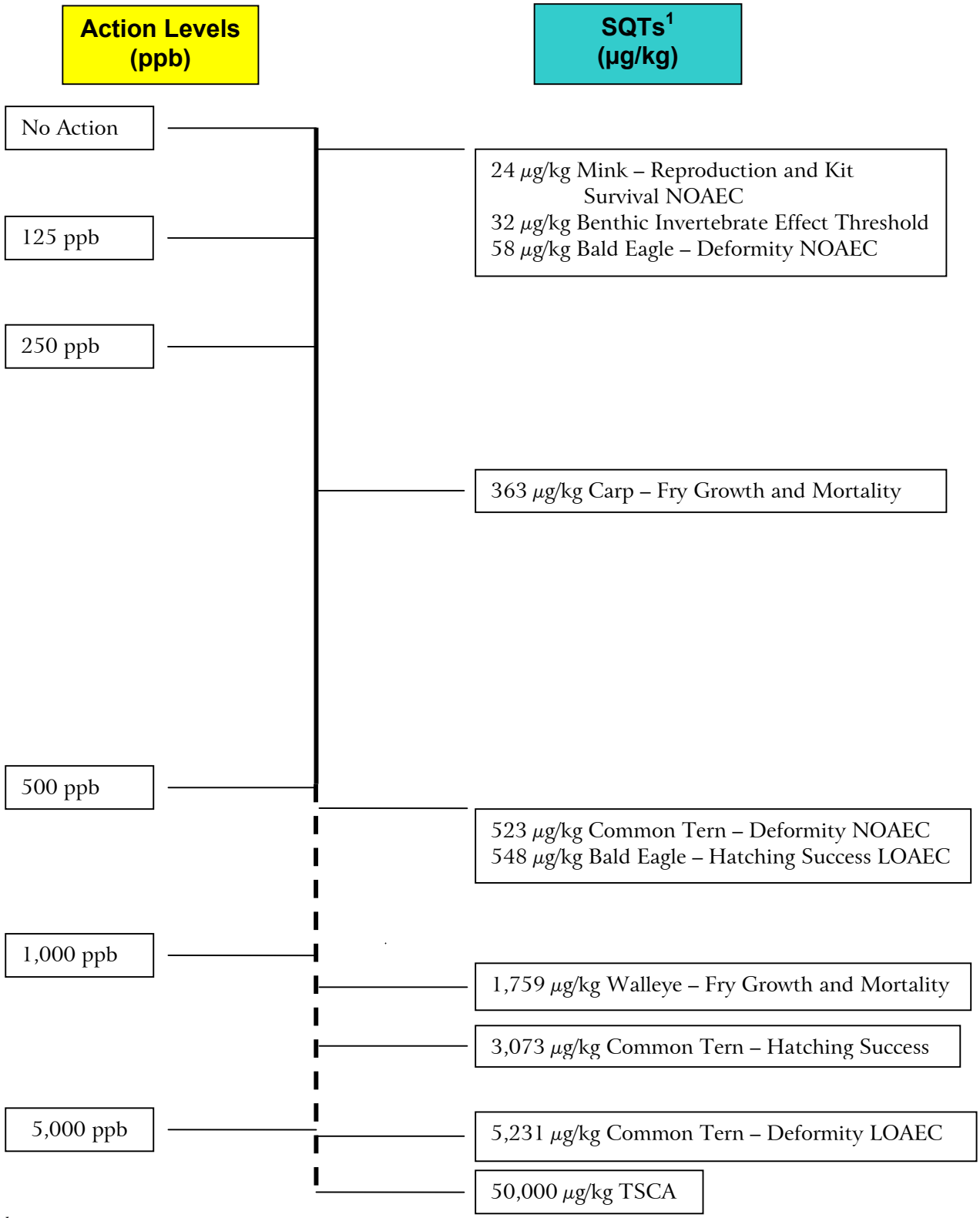


[1] With the exception of the 50,000 µg/kg TSCA number, all values are sediment quality thresholds developed in the *Baseline Human Health and Ecological Risk Assessment* (RETEC, 2002b).

10^{-5} – Risk of one additional cancer in 100,000 people. CTE – Central Tendency Exposure

HI – Hazard Index RME – Reasonable Maximum Exposure

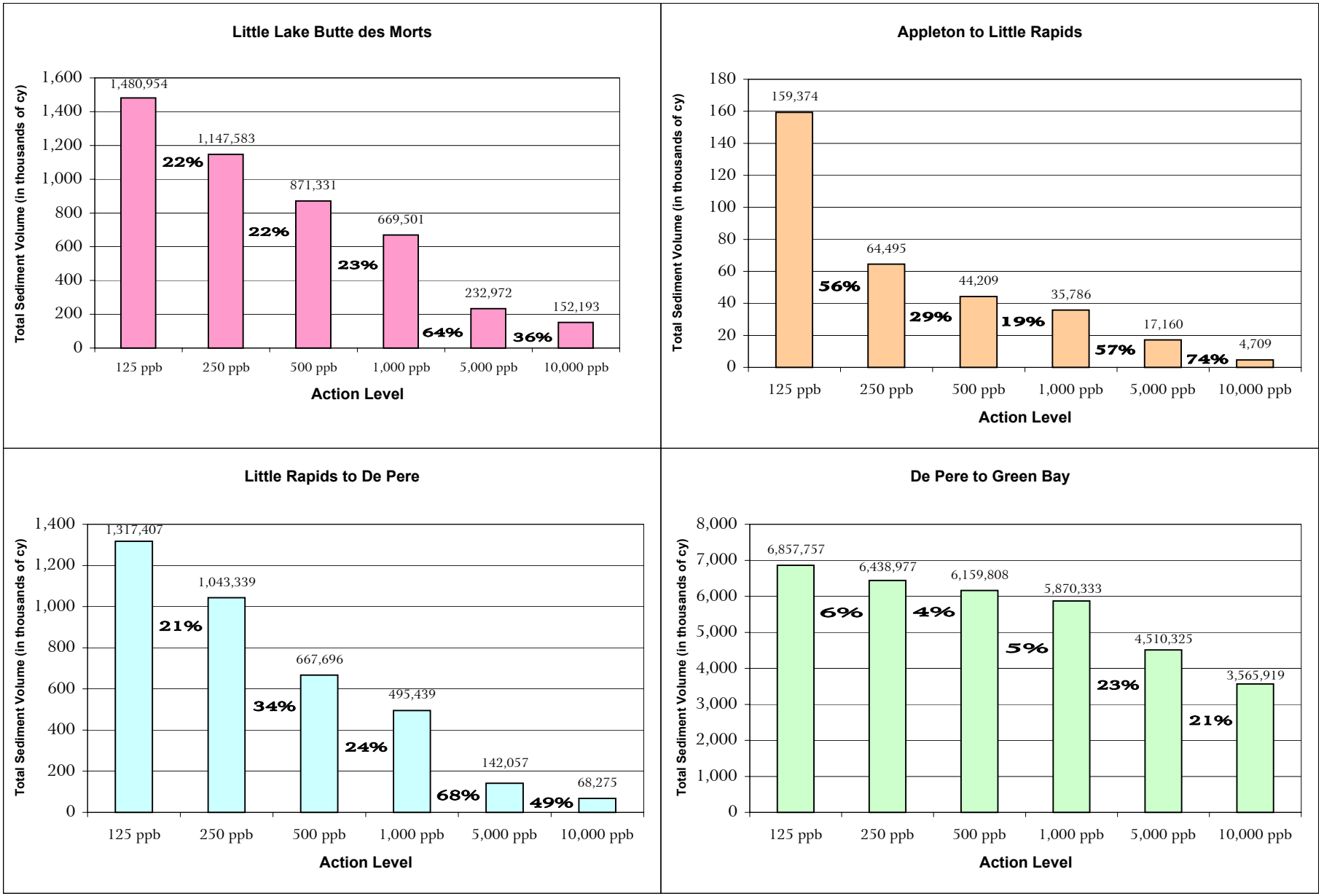
Figure 5-2 Action Levels and Sediment Quality Thresholds for Ecological Health



[1] With the exception of the 50,000 µg/kg TSCA number, all values are sediment quality thresholds developed in the *Baseline Human Health and Ecological Risk Assessment* (RETEC, 2002b).

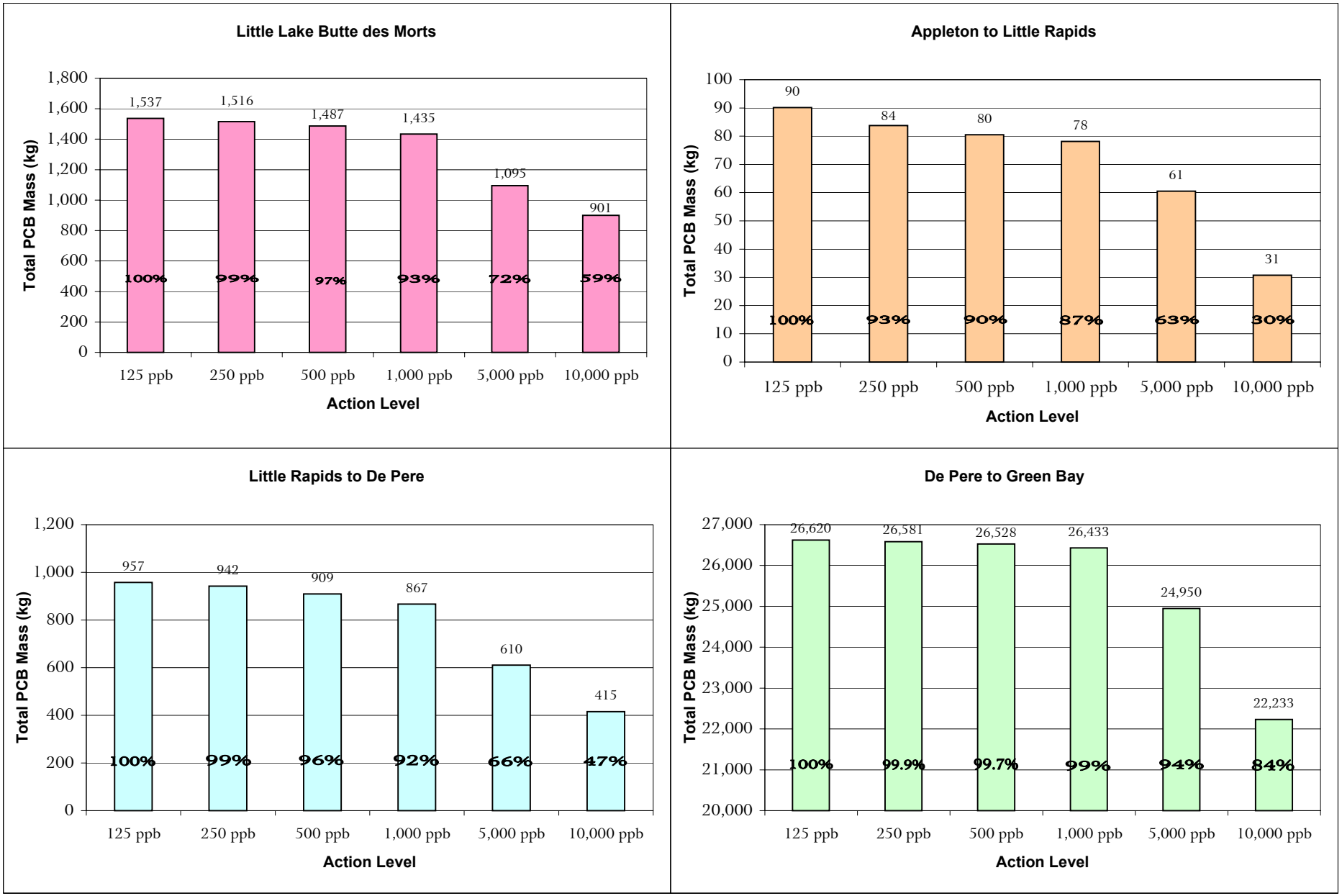
Effect Threshold – A TEL based on *Hyallela azteca* 28-day toxicity test (ARCS, 1996, as cited in RA).
LOAEC – Lowest Observable Adverse Effect Concentration
NOAEC – No Observable Adverse Effect Concentration

Figure 5-3 Total Sediment Volume versus Action Level by Reach in the Lower Fox River



Note: The embedded percentage values are the percent differences between the bracketing volumes. For example, there is a 56 percent difference in the sediment volumes removed at action levels of 125 and 250 ppb in the Appleton to Little Rapids Reach.

Figure 5-4 Total PCB Mass versus Action Level by Reach in the Lower Fox River



Note: Embedded percentages represent the percent of PCB mass theoretically removed at each action level relative to the total estimated mass at 125 ppb.

Figure 5-5 Total PCB Mass versus Sediment Volume by Reach in the Lower Fox River

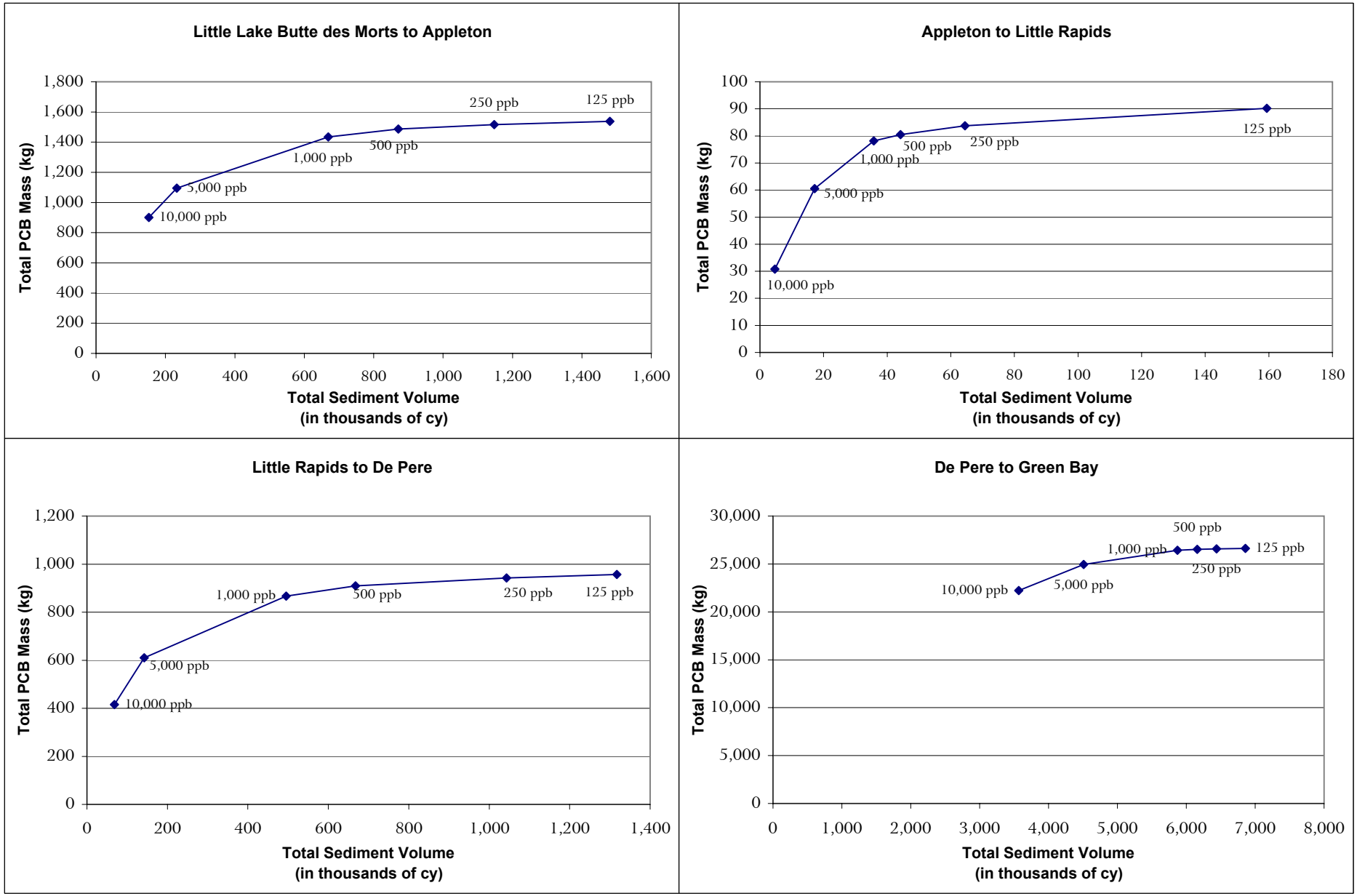
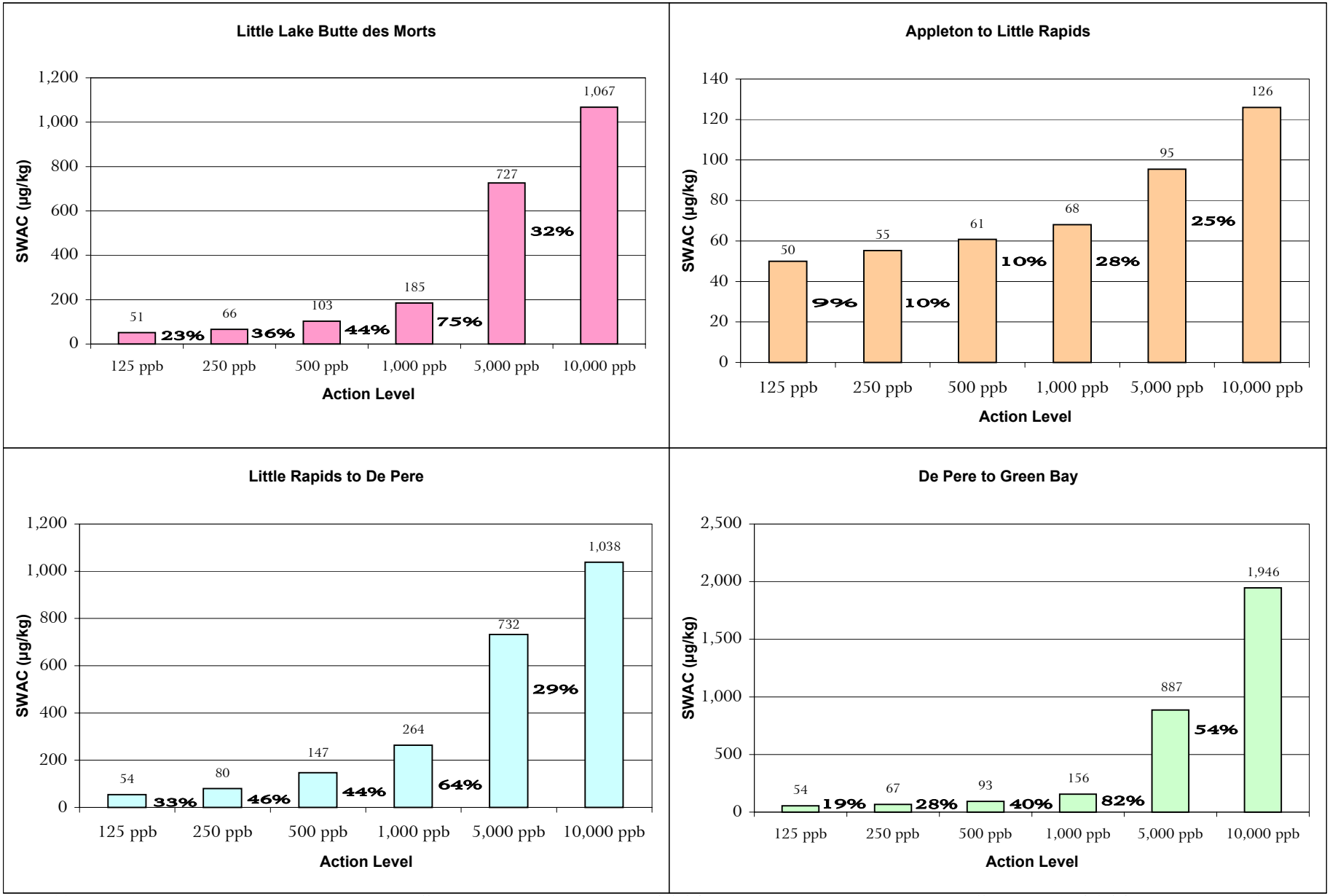
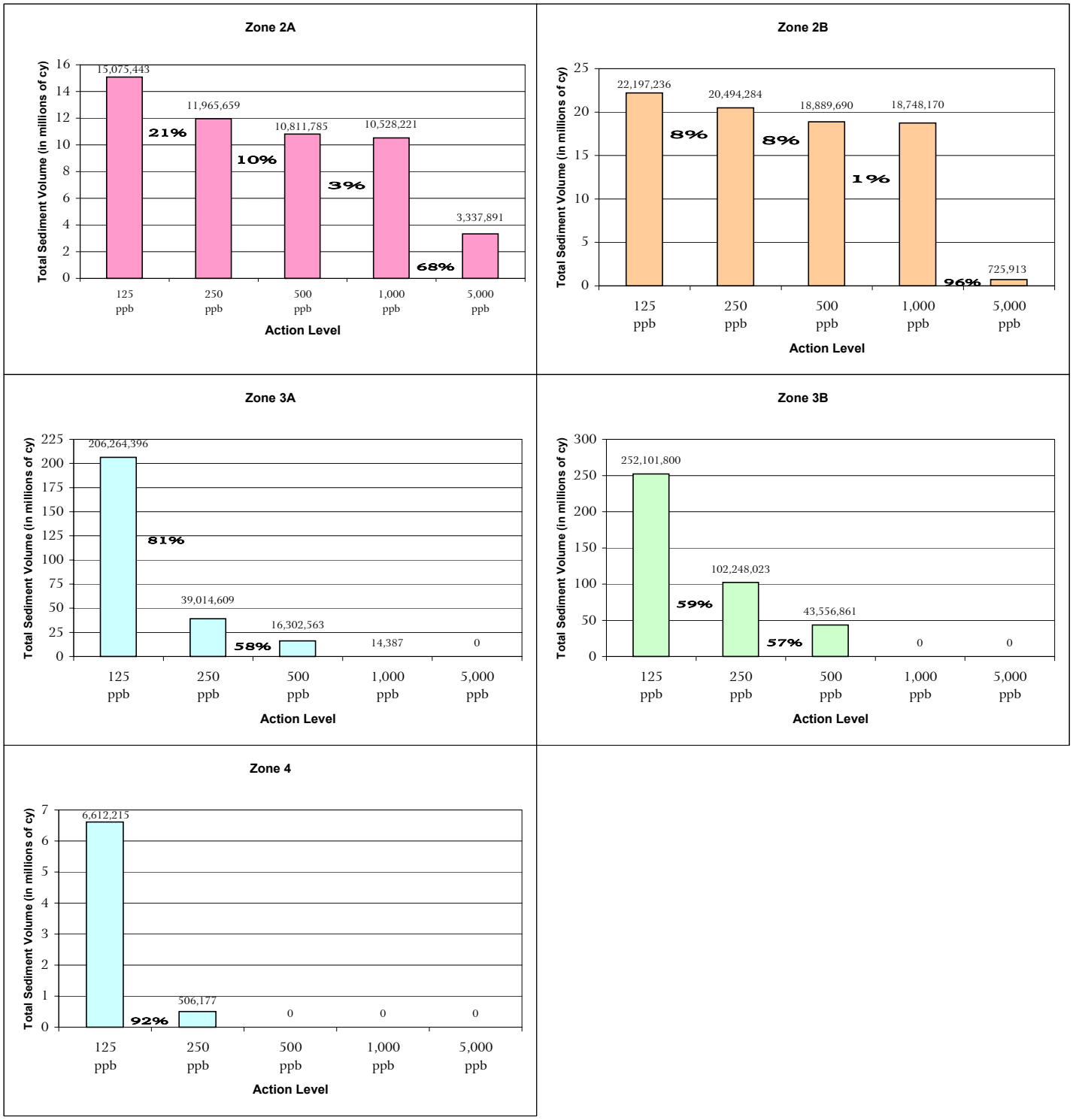


Figure 5-6 Residual SWAC versus Action Level by Reach in the Lower Fox River



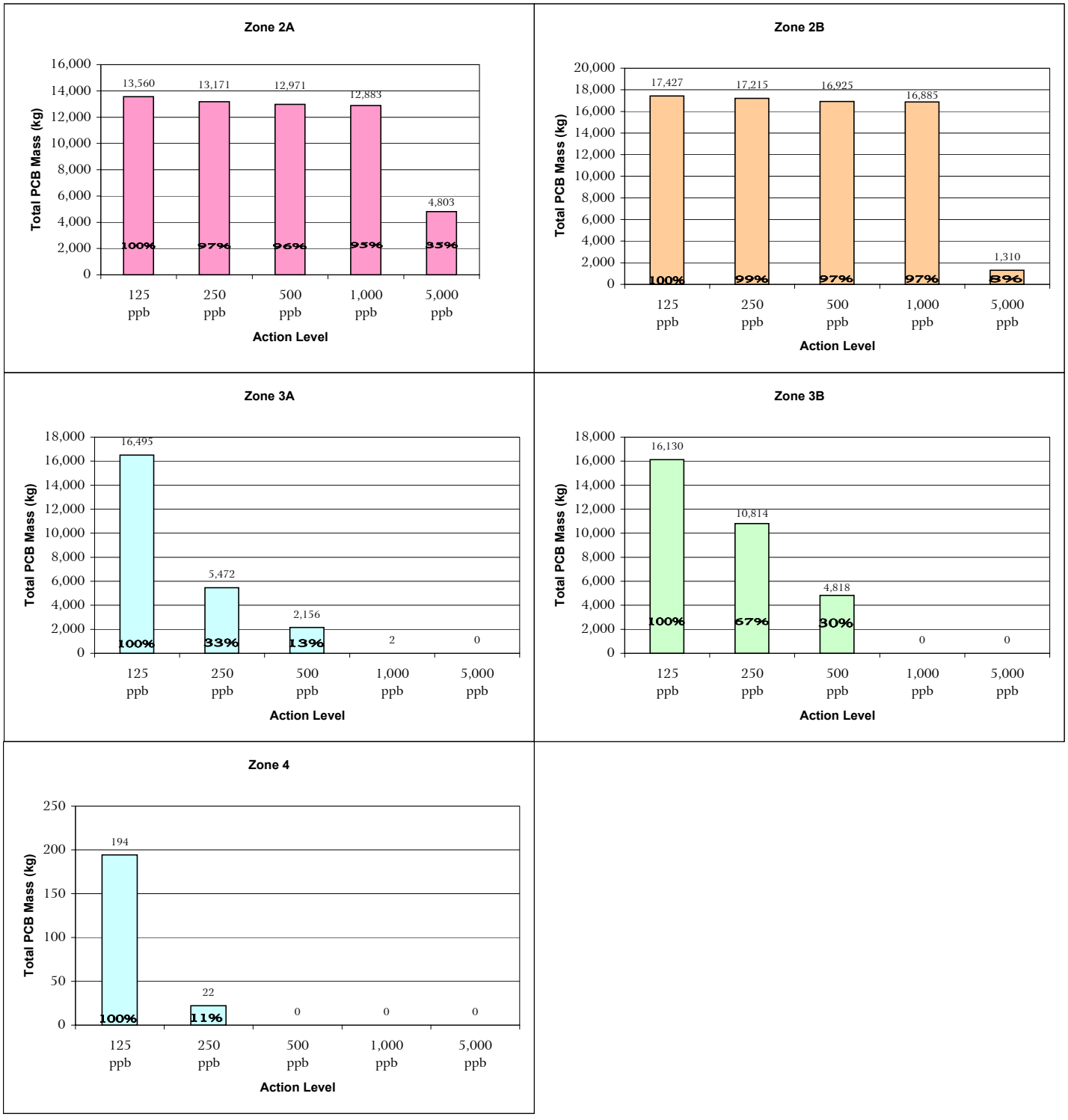
Note: The embedded percentage values are the percent differences between the bracketing SWACs. For example, there is a 9 percent difference in the SWAC at action levels of 125 and 250 ppb in the Appleton to Little Rapids Reach.

Figure 5-7 Total Sediment Volume versus Action Level by Zone in Green Bay



Note: The embedded percentage values are the percent differences between the bracketing volumes. For example, there is a 59 percent difference in the sediment volumes removed at action levels of 125 and 250 ppb in the Zone 3B.

Figure 5-8 Total PCB Mass versus Action Level by Zone in Green Bay



Note: Embedded percentages represent the percent of PCB mass theoretically removed at each action level relative to the total estimated mass at 125 ppb.

Figure 5-9 Total PCB Mass versus Sediment Volume by Zone in Green Bay

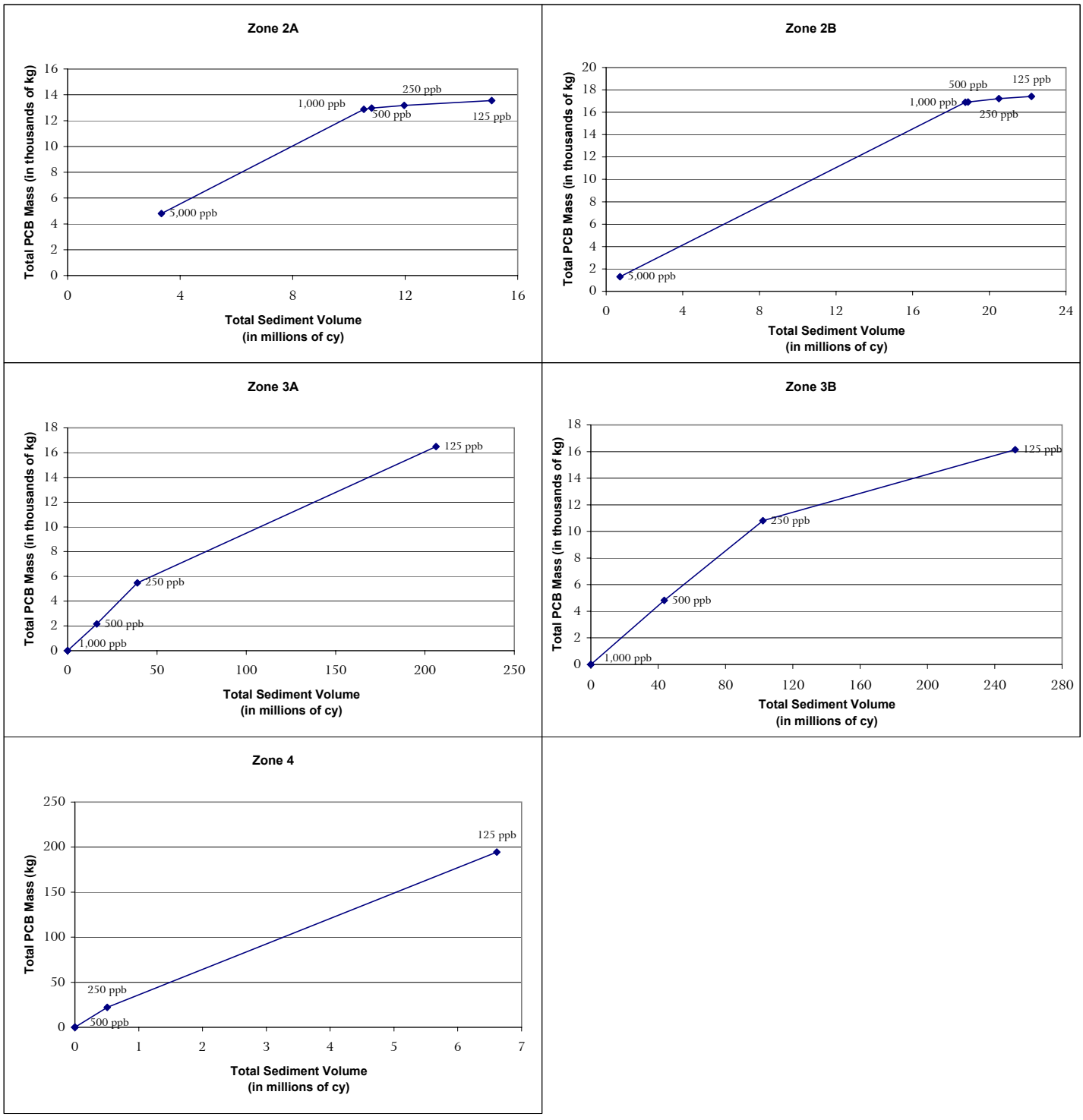
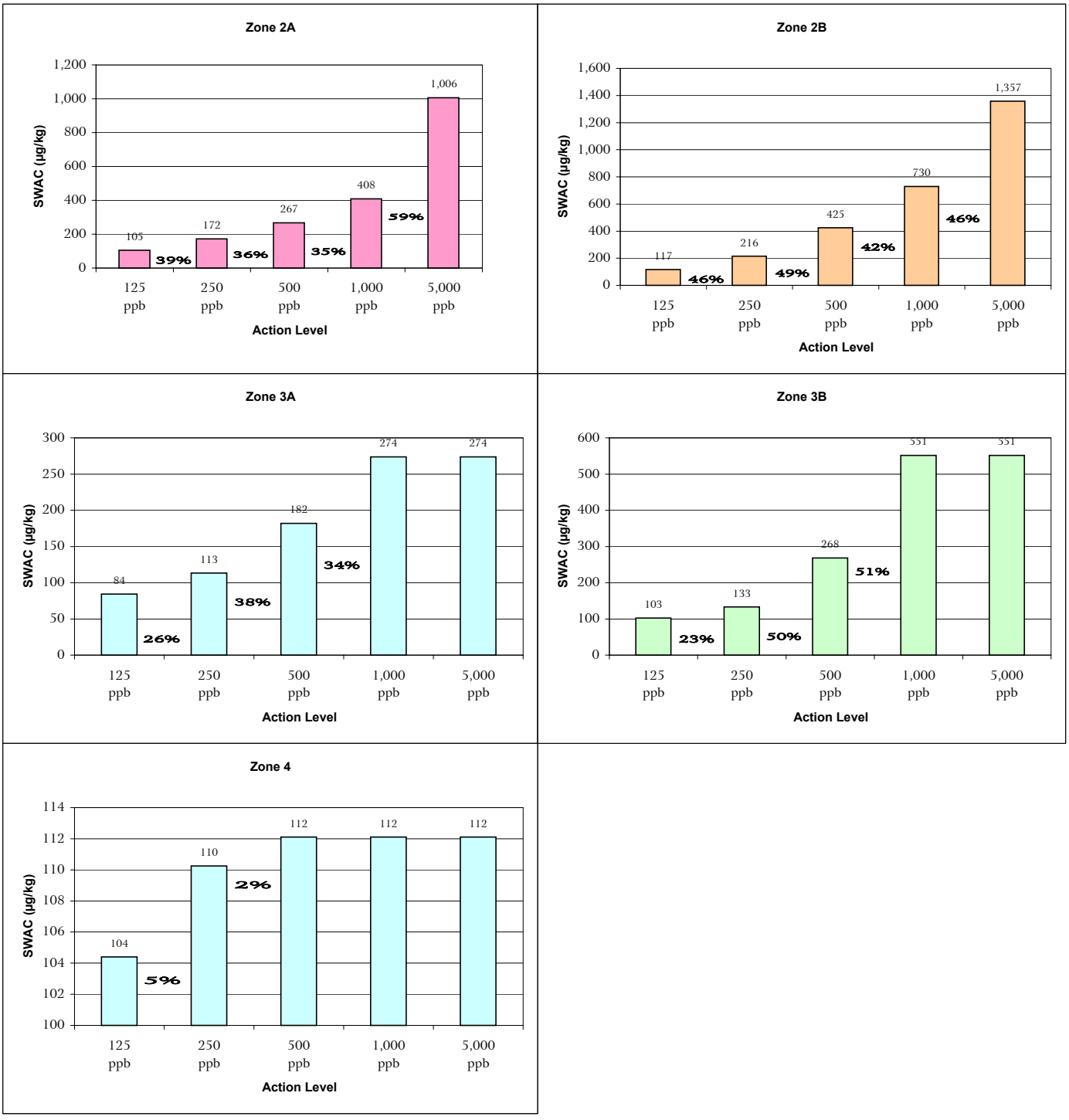


Figure 5-10 SWAC versus Action Level by Zone in Green Bay



Note: The embedded percentage values are the percent differences between the bracketing SWACs. For example, there is a 39 percent difference in the SWAC at action levels of 125 and 250 ppb in the Zone 2A.

Table 5-1 Procedure for Computing PCB Mass Removed by Dredging Sediments above Selected Action Levels

Step	Description	Action
1	Open Mask Grids: 0 for areas with sediment and 1 for areas without sediment.	Loads nine sediment mask grids.
2	Open PCB interpolated concentration grids: PCB concentration unless outside river footprint or not interpolated based on interpolation criteria.	Loads nine concentration grids.
3	Starting at bottom layer, identify areas with sediment above action level from bottom up. This will include clean sediments over deeper sediments exceeding an action level.	Generates grid for each layer with 0 if not dredged and 1 if dredged. Areas with no sediment or no interpolated concentration are set at 0.
4	Load PCB mass grids: Produced by WDNR from concentration and bulk density.	Loads nine grids of PCB mass by layer.
5	Multiply dredge grid for each layer by mass grid for each layer.	Generates grid for dredged mass in each layer.
6	Sum over all layers.	Generates single-layer grid of total volume dredged at each cell location.
7	Save mass results to statistics tables. Results are saved by deposit, by model segment, and by reach. Statistics generated include number of cells, area, minimum, maximum, range, mean, standard deviation, and sum for each category, such as for each river reach.	Generates three output tables for each action level.
8	Save mass grid from Step 5.	Grid of mass dredged for displaying dredge footprint for each action level.

Note:

Procedure uses interpolated PCB concentration grids, PCB mass grids and grids of presence or absence of sediment (mask grids). PCB concentration, PCB mass, and mask grids prepared by WDNR.

Table 5-2 Procedure for Computing SWAC for Selected Action

Step	Description	Action
1	Open Mask Grids: 0 for areas with sediment and 1 for areas without sediment.	Loads nine sediment mask grids.
2	Open PCB interpolated concentration grids: PCB concentration unless outside river footprint or not interpolated based on interpolation criteria.	Loads nine concentration grids.
3	Starting at bottom layer, identify areas with sediment above action level from bottom up. This will include clean sediments dredged to remove deeper areas exceeding an action level.	Generates grid for each layer with 0 if not dredged and 1 if dredged. Areas with no sediment or no interpolated concentration are set at 0.
4	Multiply dredge grid for each layer by thickness of layer and area of cell.	Generates grid for each layer of the volume dredged at each cell location.
5	Sum over all layers.	Generates single-layer grid of total volume dredged at each cell location.
6	Save volume results to statistics tables. Results are saved by deposit, by model segment, and by reach. Statistics generated include number of cells, area, minimum, maximum, range, mean, standard deviation, and sum for each category, such as for each river reach.	Generates three output tables for each action level.
7	Save volume grid from Step 5.	Grid of volume dredged for displaying dredge footprint for each action level.

Note:

SWAC is calculated from interpolated PCB concentration grids and grids of presence or absence of sediment (mask grids). PCB concentration and mask grids prepared by WDNR.

Table 5-3 PCB Mass and Sediment Volume by Action Level—Lower Fox River

River Reach / Deposit	Sediment Volume Based on Action Levels (cy) [1]						PCB Mass Based on Action Levels (kg) [1]						
	125 ppb	250 ppb	500 ppb	1,000 ppb	5,000 ppb	10,000 ppb	Total [2]	125 ppb	250 ppb	500 ppb	1,000 ppb	5,000 ppb	10,000 ppb
Little Lake Butte des Morts													
A	140,801	140,539	140,487	139,964	30,841	20,744	238	238	237	237	237	135	112
B	49,951	44,784	43,856	42,835	38,035	30,423	411	411	410	410	409	396	353
C	78,098	75,691	30,174	25,989	7,468	1,256	39	39	39	36	35	20	3
D	87,136	85,305	78,215	69,858	9,718	0	83	83	83	81	78	22	0
E	862,973	568,972	433,089	276,318	83,500	44,719	453	450	432	415	373	243	165
F	123,287	101,196	23,726	8,593	0	0	11	11	10	4	3	0	0
G	3,662	0	0	0	0	0	0.7	0.3	0	0	0	0	0
H	902	902	902	301	0	0	0.7	0.7	0.7	0.7	0.4	0	0
POG	134,143	130,193	120,881	105,643	63,409	55,052	305	305	304	303	299	279	267
Interdeposit Areas							309	276					
Reach Total:	**1,480,954**	**1,147,583**	**871,331**	**669,501**	**232,972**	**152,193**	**1,850**	**1,813**	**1,516**	**1,487**	**1,435**	**1,095**	**901**
Appleton to Little Rapids													
I	2,668	889	889	0	0	0	0.2	0.4	0.3	0.3	0	0	0
J	0	0	0	0	0	0	0.1	0	0	0	0	0	0
K	209	209	0	0	0	0	0.1	<0.1	<0.1	0	0	0	0
L	249	249	0	0	0	0	0.1	<0.1	<0.1	0	0	0	0
M	1,844	1,844	615	0	0	0	0.2	0.3	0.3	0.1	0	0	0
N	6,383	6,383	6,370	6,108	3,165	2,158	30	30	30	30	30	22	19
O	3,100	3,021	2,943	1,059	0	0	2	2	2	2	0.9	0	0
P	16,742	16,742	10,045	10,045	0	0	5.3	5	5	4	4	0	0
Q	275	275	249	196	0	0	0.2	0.2	0.2	0.2	0.2	0	0
R	0	0	0	0	0	0	0	0	0	0	0	0	0
S	2,721	2,721	2,721	0	0	0	0.1	0	0	0	0	0	0
T	6,330	6,330	6,330	6,330	3,048	0	11.3	11	11	11	11	7	0
U	785	785	262	0	0	0	0.2	0.2	0.2	0.1	0	0	0
V	78	78	26	26	0	0	0	<0.1	<0.1	<0.1	<0.1	0	0
W	42,862	6,592	1,256	981	0	0	6.8	5	2	0.5	0.5	0	0
X	41,305	2,080	0	0	0	0	2.5	2	0.2	0	0	0	0
Y	562	562	0	0	0	0	0.3	0.1	0.1	0	0	0	0
Z	955	955	0	0	0	0	0.4	0.2	0.2	0	0	0	0
AA	0	0	0	0	0	0	0	0	0	0	0	0	0
BB	340	0	0	0	0	0	0.1	0	0	0	0	0	0
CC	4,460	1,583	1,465	0	0	0	0.7	0.6	0.5	0.4	0	0	0
DD	27,506	13,197	11,039	11,039	10,948	2,551	34	33	32	31	31	31	12
Interdeposit Areas							15	45					
Reach Total:	**159,374**	**64,495**	**44,209**	**35,786**	**17,160**	**4,709**	**110**	**135**	**84**	**80**	**78**	**61**	**31**

Table 5-3 PCB Mass and Sediment Volume—Lower Fox River (Continued)

River Reach / Deposit	Sediment Volume Based on Action Levels (cy) [1]						PCB Mass Based on Action Levels (kg) [1]						
	125 ppb	250 ppb	500 ppb	1,000 ppb	5,000 ppb	10,000 ppb	Total [2]	125 ppb	250 ppb	500 ppb	1,000 ppb	5,000 ppb	10,000 ppb
Little Rapids to De Pere													
EE	1,254,456	984,246	609,401	440,675	112,745	47,217	828	806	791	758	716	492	312
FF	471	471	0	0	0	0	0.1	<0.1	<0.1	0	0	0	0
GG	23,962	23,308	22,981	22,850	16,232	14,374	81	81	81	81	81	72	69
HH	38,519	35,315	35,315	31,914	13,080	6,684	70.2	70	70	70	70	45	35
Interdeposit Areas							266	244					
Reach Total:	**1,317,407**	**1,043,339**	**667,696**	**495,439**	**142,057**	**68,275**	**1,245**	**1,201**	**942**	**909**	**867**	**610**	**415**
De Pere to Green Bay													
Group 20 to 25	1,295,316	1,213,046	1,157,275	1,081,270	802,716	679,088		5,558	5,551	5,541	5,515	5,225	4,903
Group 26 to 31	198,246	169,432	163,651	157,673	107,841	64,142		761	758	757	754	649	478
Group 32 to 37	289,175	281,353	257,156	250,970	202,798	116,238		1,174	1,173	1,167	1,165	1,099	720
Group 38 to 43	458,973	420,519	379,240	346,555	227,060	162,591		1,148	1,145	1,136	1,125	987	788
Group 44 to 49	1,753,007	1,704,116	1,632,781	1,538,713	1,169,897	887,288		5,213	5,209	5,197	5,170	4,833	4,065
Group 50 to 55	512,651	492,535	477,114	456,266	325,758	260,295		1,831	1,829	1,826	1,819	1,667	1,494
Group 56 to 61	636,305	633,755	630,289	621,813	577,657	533,879		5,812	5,812	5,811	5,808	5,767	5,681
Group 62 to 67	249,125	246,052	240,323	231,050	163,494	109,475		862	861	861	859	799	711
Group 68 to 73	420,689	389,900	375,565	363,676	291,869	265,527		1,858	1,855	1,853	1,850	1,770	1,690
Group 74 to 79	153,723	140,945	134,941	129,644	123,693	101,942		429	427	426	425	416	338
Group 80 to 85	184,029	123,719	98,463	91,923	62,782	39,893		384	380	374	372	327	241
Group 86 to 91	133,123	93,610	91,099	89,464	85,932	24,197		253	249	249	248	245	98
Group 92 to 97	145,980	130,782	126,178	121,038	46,890	0		255	253	251	248	137	0
Group 98 to 103	67,307	40,821	38,859	34,151	24,720	24,720		93	90	89	87	79	79
Group 104 to 109	90,340	89,791	89,791	89,438	38,061	38,061		150	150	150	150	116	116
Group 110 to 115	269,765	268,601	267,084	266,691	259,157	258,582		840	840	839	839	833	832
Reach Total:	**6,857,757**	**6,438,977**	**6,159,808**	**5,870,333**	**4,510,325**	**3,565,919**	**26,620**	**26,620**	**26,581**	**26,528**	**26,433**	**24,950**	**22,233**

Notes:

[1] Estimated mass or volume of sediment to be removed or isolated at a specific action level.

[2] Total PCB mass presented above were generated from a GIS map query of the Lower Fox River model layers. The mass contained in each model layer was summed to provide the total mass. Values may differ slightly from those listed in the Fox River Database (FRDB), in Section 2 of the FS, and in the RI Report (generated from the FRDB). Values may differ slightly from those listed in Section 7 of the FS Report since Section 7 includes overburden volumes and PCB mass required for removal. Use the Section 7 volumes and masses for remediation estimates.

Table 5-4 SWAC Based on Action Levels—Lower Fox River

River Reach	Residual SWAC (ppb) Based on Action Levels					
	125 ppb	250 ppb	500 ppb	1,000 ppb	5,000 ppb	10,000 ppb
Little Lake Butte des Morts	51	66	103	185	727	1,067
Appleton to Little Rapids	50	55	61	68	95	126
Little Rapids to De Pere	54	80	147	264	732	1,038
De Pere to Green Bay	54	67	93	156	887	1,946

Note:

Estimated residual surface-weighted average concentration (SWAC) of PCBs in surface sediment after removal.

Table 5-5 PCB Mass, Volume and SWAC—Green Bay

Bay Zone	Volume Based on Action Levels (cy)					PCB Mass Based on Action Levels (kg)					SWAC Based on Action Levels (ppb)				
	125 ppb	250 ppb	500 ppb	1,000 ppb	5,000 ppb	125 ppb	250 ppb	500 ppb	1,000 ppb	5,000 ppb	125 ppb	250 ppb	500 ppb	1,000 ppb	5,000 ppb
Zone 2A	15,075,443	11,965,659	10,811,785	10,528,221	3,337,891	13,560	13,171	12,971	12,883	4,803	105	172	267	408	1,006
Zone 2B	22,197,236	20,494,284	18,889,690	18,748,170	725,913	17,427	17,215	16,925	16,885	1,310	117	216	425	730	1,357
Zone 2	37,272,680	32,459,943	29,701,474	29,276,390	4,063,804	30,986	30,386	29,895	29,768	6,113	222	388	692	1,138	2,363
Zone 3A	206,264,396	39,014,609	16,302,563	14,387	0	16,495	5,472	2,156	2	0	84	113	182	274	274
Zone 3B	252,101,800	102,248,023	43,556,861	0	0	16,130	10,814	4,818	0	0	103	133	268	551	551
Zone 4	6,612,215	506,177	0	0	0	194	22	0	0	0	104	110	112	112	112

Notes:

[1] Estimated mass or volume of sediment to be removed or isolated at a specific action level.

[2] Estimated residual SWAC concentration in surface sediments after removal.